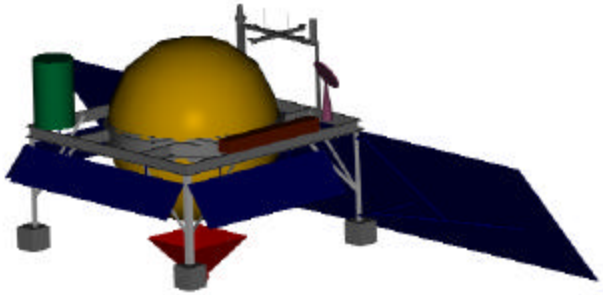
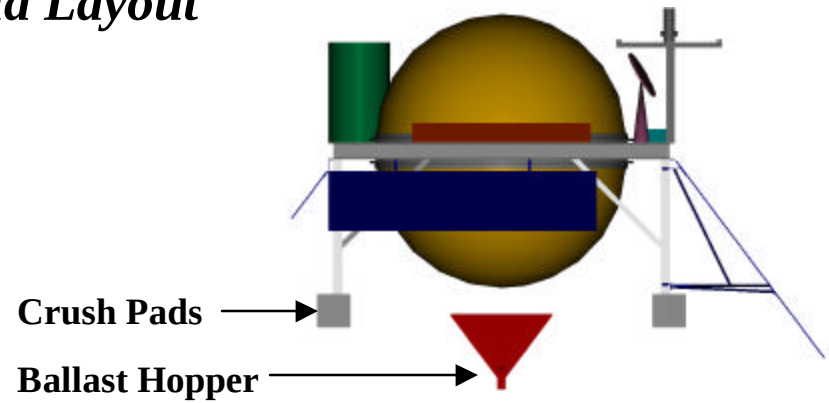
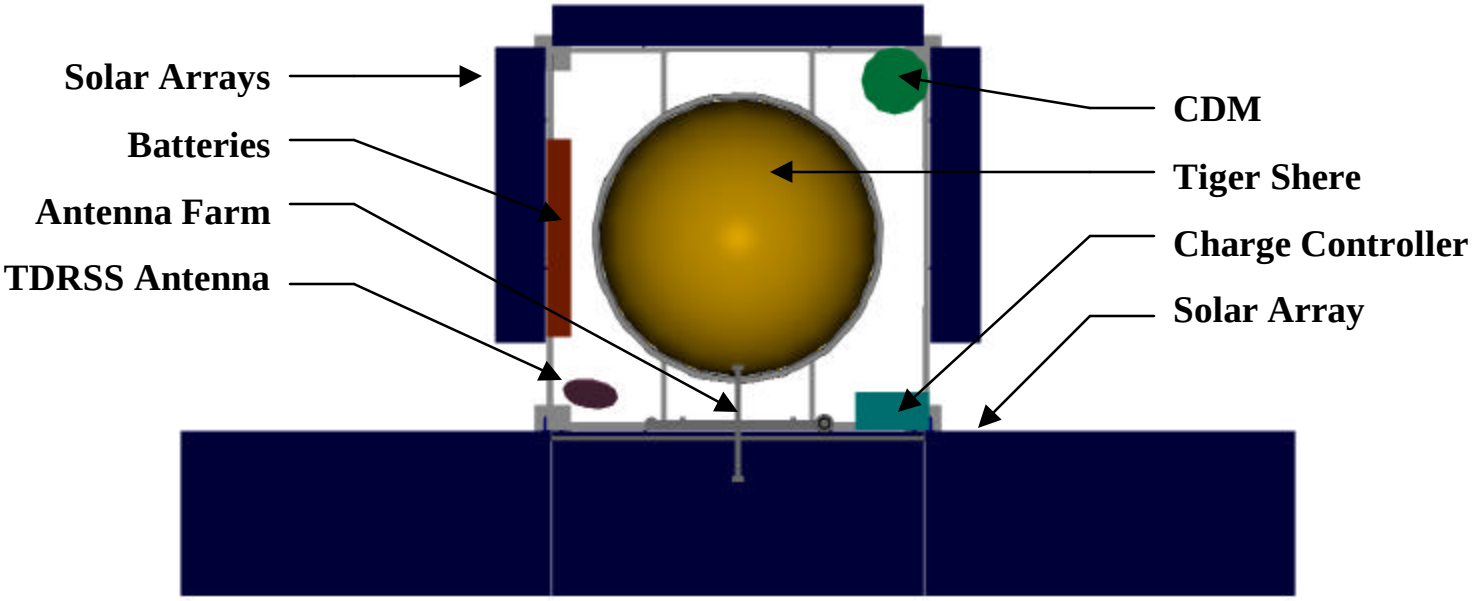
CDM Presentation

Gondola Layout





Side View



Top View

ULDB PDR

3.9 Mechanical

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CDM - Command /Data Module

- **Requirements Traceability from DTRD**
  - **No Requirements defined for CDM**
  - **Desired Characteristics**
    - Provide thermal environment
    - Durable
    - Modular
    - Accessible
- **Candidate Designs for Trade Study**
  - Single Module Sealed, with Gas Makeup
  - Single Module not Sealed, With Hard Cover
  - Multiple Modules not Sealed, using Multiple Boxes
  - Single Module not Sealed, with thermal blanket cover
  - Mount all Components in Tiger Sphere

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- **Functional and Performance Requirements**
  1. Provide environment that complies with the operating parameters of all components for temperature and pressure.
     - Most components have operating range from -20° to 60° C
     - Hard Drives 5° to 50° C, and require 10 to 15.1 psi absolute pressure environment.
  2. Structural
     - Design to 10G load, chute deploy
     - Ground impact protection
     - Environment protection
  3. Modular
     - Accommodate various component configurations for telemetry and data handling
  4. Accessible
     - Provide easy interface to external systems
     - Provide easy service access

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CDM - Command /Data Module

- **Verification Matrix**

	DESCRIPTION	METHOD	STAGE
1.0	**Environment Compliance**		
1.1	Thermal Design & Layout	Analysis, Thermal	Development
1.2	Thermal Performance	Thermal Test	Development
		Thermal Vacuum Test	Qualification
		Test Flight 1999	Qualification
1.3	Pressure Performance	Thermal Pressure Test	Development
		Thermal Vacuum Test	Qualification
		Test Flight 1999	Qualification
2.0	**Structural**		
2.1	Design	Analysis, Structural	Development
2.2	Fabrication	Inspection	Development
2.3	Hardware Validation	Vibration/Shock Test	Qualification
		Test Flight 1999	Qualification
3.0	**Modularity**	Demonstration	Development
4.0	**Accessibility**	Demonstration	Development

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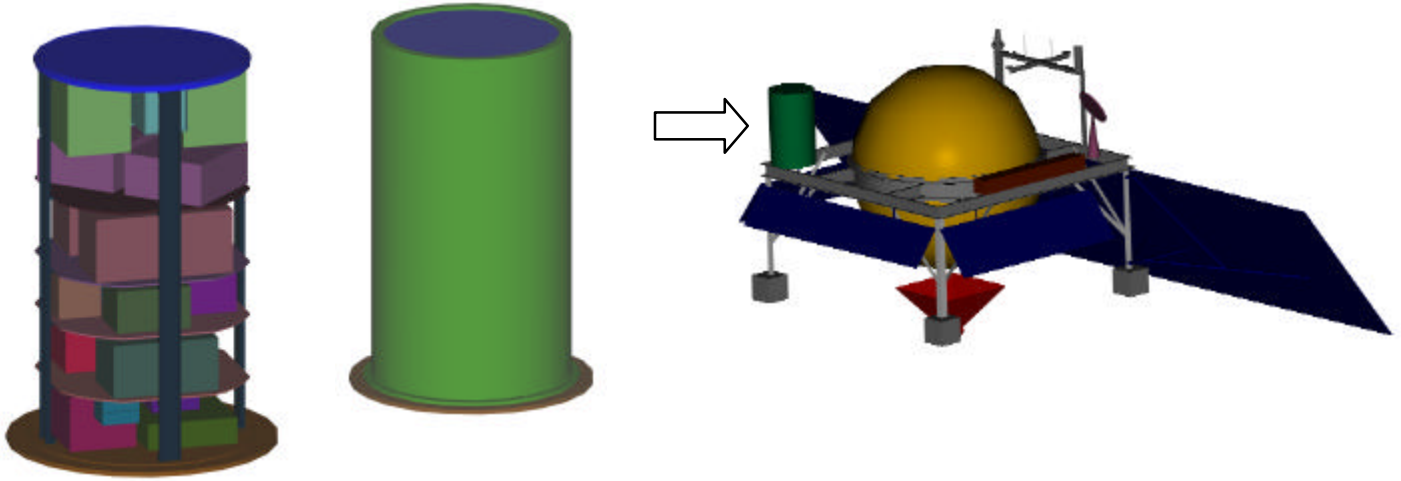
- **Selected Design -** Sealed Module with Gas Makeup
  - Aluminum container, dual O-ring seals top and bottom decks.
  - Interface bulkhead through top and bottom deck (connectors not shown).
  - Gas makeup system using composite storage bottle and absolute pressure regulator, controls pressure from 10 to 15 psi absolute.
  - Top deck attached to longerons with floating fasteners to compensate for temperature induced expansion and contraction of skin.
  - Circulating fans will force gas up through center of structure.



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- **Properties**
  - Diameter: 20.5 inches , Height: 36.5 inches
  - Total Weight: 190 lbs.
  - Center of Gravity: 15 inches from base.
  - Total Heat Output ~160 watts
- **Sensors**
  - Pressure Transducers
    - Measure pressure inside CDM
    - Makeup gas supply
  - Temperature Sensors
    - Decks 1, 2, 5, and 6 inside CDM
    - 2 sensors on inside skin surface, one on hot side, one on cold side
    - All components over 1 watt, 10 sensors

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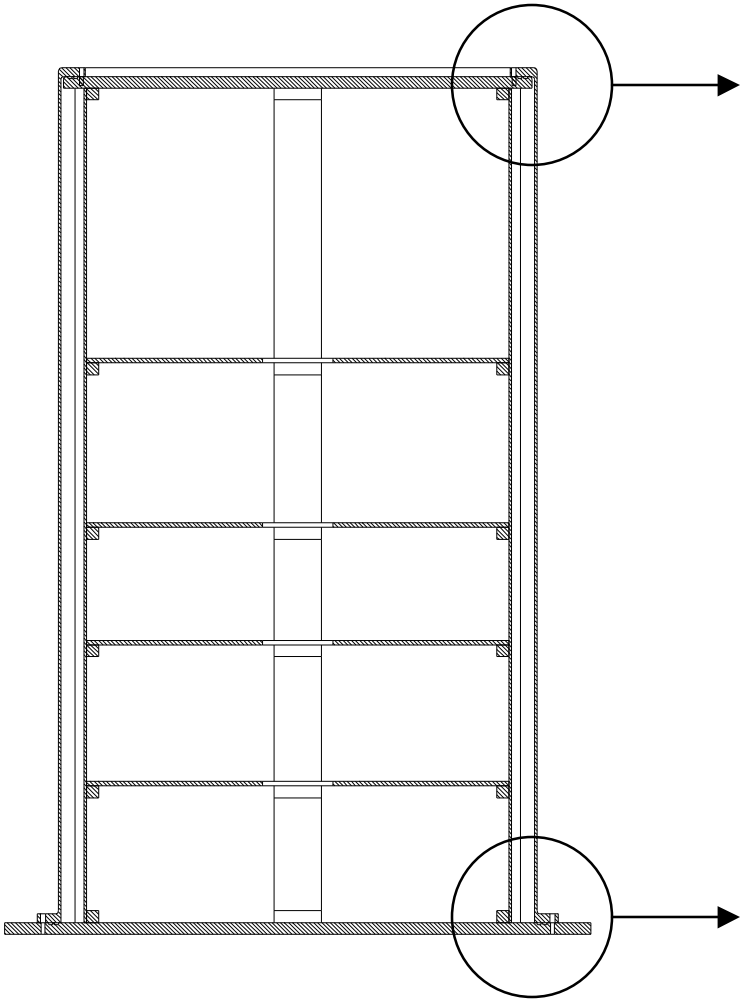
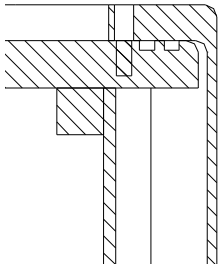
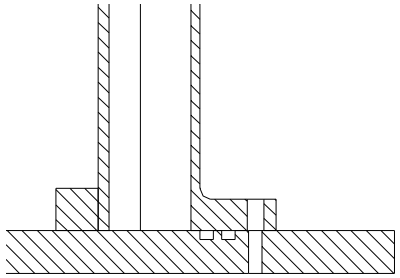
CDM - Command /Data Module



CDM Sectional View



Upper Bulkhead Detail



Lower Bulkhead Detail

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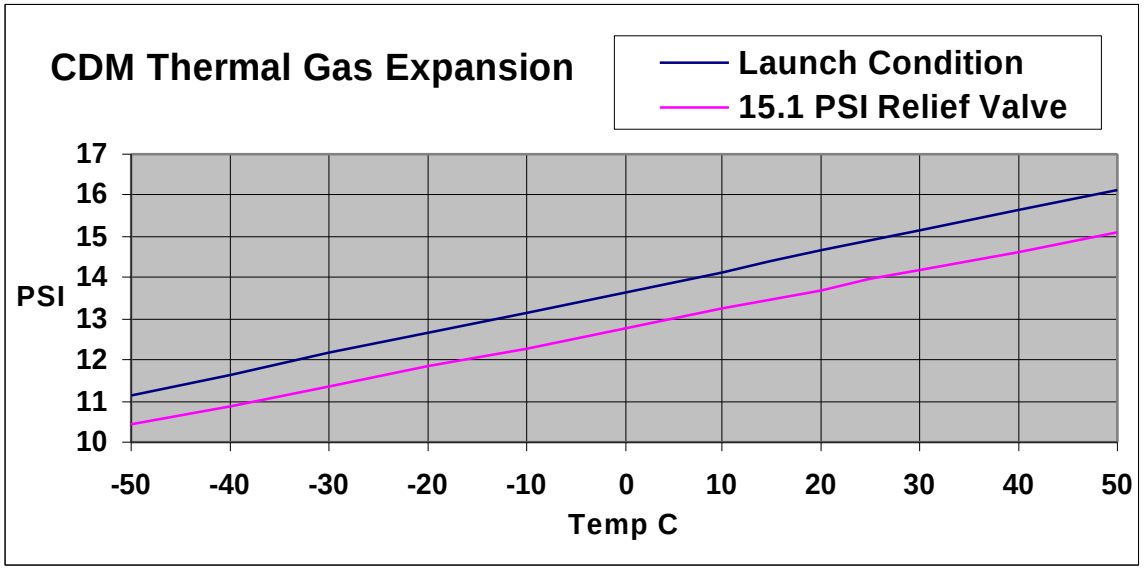
- **Gas Makeup System**
  - **Gas Makeup System Parameters**
    - Pressure Limits for Hard Drives 10 to 15.1 psi absolute
    - Makeup Regulator set to 10 psia
    - Back Pressure Regulator set to 15 psia
    - No day/night cycle makeup gas usage from venting if temperature range is maintained between -50° and 50°c.



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CDM - Command /Data Module

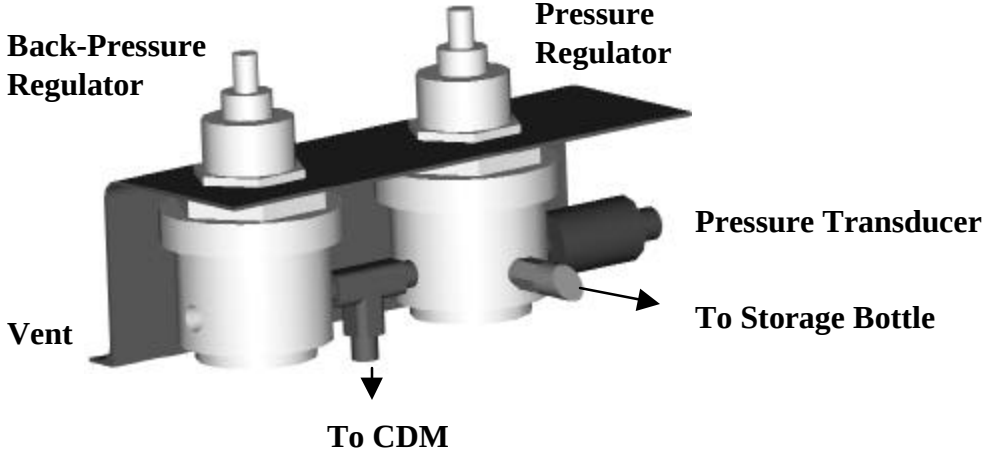
- **Gas Makeup System Assembly**

– **Graphite Composite Storage Bottle**
  - 45 ft³ capacity, 6.5 lbs

– **Sub-Atmospheric Pressure Regulator**
  - Outlet range 67 mbar to 2 bar absolute
  - Operating temperature -40° to 74°C

– **Back Pressure Regulator**
  - Low crack to reseat pressure differential

– **Relief Valve**
  - Provides system runaway protection



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CDM - Command /Data Module

- **Risk Assessment & Mitigation/Reliability**
  - Pressure loss due to seal failure, gas makeup system failure.
    - **Risk:** Loss of pressure control and convection thermal control.
    - **Mitigation/Reliability:** Redundant pressure vessels for Hard Drives, they will be sealed in an enclosure inside CDM. CDM seal failure alone will not cause pressure loss if leak is less than .43 in^3/min @ 1 atm, gas makeup system can keep up with the leak. Design optimization through thermal analysis, pressure testing, thermal vacuum testing, and test flight from Alice Springs, 1999.
  - Structural failure from overpressure caused by gas expansion or regulator failure.
    - **Risk:** Loss of pressure control and convection thermal control.
    - **Mitigation/Reliability:** Redundant pressure relief through back pressure regulator and safety relief valve. Thermal vacuum testing, and test flight from Alice Springs, 1999.

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- **Test Plan**
  - CDM Pressure Vessel
    - Thermal cycle -50° to +50° C, number of cycles TBD
    - Leak check, characterize leak rate.
    - Pressure test to 45 PSI
  - Gas Makeup
    - Thermal cycle -50° to +50° C, number of cycles TBD
    - Thermal calibration checks

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CDM - Command /Data Module

- **Mechanical Design Work to be Completed**
  - Provide Thermal Analysis Team with actual box thicknesses for components.
  - Define new operational mode for hard drives.
  - Identify bulkhead connectors and add to bulkhead design.
  - Optimize design.

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